

1970

117)

no name / [Luna]

Nation: USSR (70)

Objective(s): lunar sample return

Spacecraft: Ye-8-5 (no. 405)

Spacecraft Mass: c. 5,700 kg

Mission Design and Management: GSMZ

Lavochkin

Launch Vehicle: 8K82K + Blok D (Proton no. 247-01)

Launch Date and Time: 6 February 1970 / 04:16:06 UT

Launch Site: NIIP-5 / launch site 81

Scientific Instruments:

- 1) stereo imaging system
- 2) remote arm for sample collection
- 3) radiation detector

Results: This attempt continued the spate of failures on the robotic lunar sample return program. On this fifth attempt to recover soil from the Moon, the Proton booster failed to deposit its payload in Earth orbit. An erroneous command shut down the second stage at T+127 seconds, and the booster was destroyed. Subsequently, the design organization responsible for the Proton, the TsKBM, implemented a thorough review of the Proton's performance and completed a simple suborbital diagnostic flight in August 1970 to verify corrective measures.

118)

Venera 7

Nation: USSR (71)

Objective(s): Venus landing

Spacecraft: 3V (no. 630)

Spacecraft Mass: 1,180 kg

Mission Design and Management: GSMZ

Lavochkin

Launch Vehicle: 8K78M

Launch Date and Time: 17 August 1970 / 05:38:22 UT

Launch Site: NIIP-5 / launch site 31

Scientific Instruments:

Bus:

- 1) solar wind detector
- 2) cosmic-ray detector

Lander:

- 1) resistance thermometer
- 2) aneroid barometer

Results: Venera 7 was one of a pair of spacecraft prepared by the Soviets in 1970 to make a survivable landing on the surface of Venus. The spacecraft were quite similar in design to Veneras 4, 5, and 6, with a main bus and a spherical lander (now with a mass of 500 kilograms). After the last mission, engineers redesigned the landing capsule to withstand pressures of up to 180 atmospheres and temperatures of up to 540°C. Venera 7 successfully left Earth orbit and implemented two mid-course corrections on 2 October and 17 November, respectively, before beginning its

Venus encounter operations on 12 December 1970 when the lander probe's batteries were charged up (using solar panels on the bus) and the internal temperature lowered. At 04:58:44 UT on 15 December, the lander separated from the bus and entered the Venusian atmosphere at an altitude of 135 kilometers and a velocity of 11.5 kilometers per second. When aerodynamic drag had reduced velocity down to 200 meters per second at an altitude of 60 kilometers, the parachute system deployed. Within 35 minutes, at 05:34:10 UT, the capsule was on the Venusian landscape. Although transmissions appeared to have ended at the moment of landing, Soviet ground tracking stations recorded what at first proved to be unintelligible noise. After computer processing of the data, Soviet scientists discovered a valuable 22 minutes 58 seconds of information from the capsule—the first transmissions of spacecraft from the surface of another planet. Quite likely, the initial loss of signal occurred when the capsule tipped over on its side. Venera 7's data indicated a surface temperature of $475 \pm 20^{\circ}\text{C}$ and a pressure of 90 ± 15 atmospheres. The information was a good fit with previous Soviet and American estimates. Impact point was 5° south latitude and 351° longitude.

119)

Kosmos 359 / [Venera]

Nation: USSR (72)

Objective(s): Venus landing

Spacecraft: 3V (no. 631)

Spacecraft Mass: c. 1,200 kg

Mission Design and Management: GSMZ

Lavochkin

Launch Vehicle: 8K78M

Launch Date and Time: 22 August 1970 / 05:06:09 UT

Launch Site: NIIP-5 / launch site 31

Scientific Instruments:

Bus:

- 1) solar wind detector
- 2) cosmic-ray detector

Lander:

- 1) resistance thermometer
- 2) aneroid barometer

Results: This was the second of a pair of probes designed to land on Venus and transmit information back to Earth. In this case, after the spacecraft had reached Earth orbit, the main

engine of the Blok L upper stage was late in igniting and cut off early (after only 25 seconds) due to incorrect operation of a sequencer and a failure in the DC transformer in the power supply system. The payload remained stranded in orbit, eventually reentering Earth's atmosphere on 6 November 1970. The spacecraft was named Kosmos 359 by the Soviet press to disguise the failure.

120)

Luna 16

Nation: USSR (73)

Objective(s): lunar sample return

Spacecraft: Ye-8-5 (no. 406)

Spacecraft Mass: 5,727 kg

Mission Design and Management: GSMZ

Lavochkin

Launch Vehicle: 8K82K + Blok D (Proton-K no. 248-01)

Launch Date and Time: 12 September 1970 / 13:25:53 UT

Launch Site: NIIP-5 / launch site 81L

Scientific Instruments:

- 1) stereo imaging system
- 2) remote arm for sample collection
- 3) radiation detector

Results: Luna 16 was a landmark success for the Soviets in their deep space exploration program; the mission accomplished the first fully automatic recovery of soil samples from the surface of the Moon. The success came after five failures. After a successful coast to the Moon (which included one midcourse correction), Luna 16 entered circular lunar orbit (at 110 kilometers with a 70° inclination) on 17 September. Two further orbital adjustments on 18 and 19 September altered both altitude and inclination in preparation for descent to the Moon. At perilune at 05:12 UT on 20 September, Luna 16 fired its main engine to begin its descent to the surface. Six minutes later, the spacecraft safely soft-landed in its target area at $0^{\circ}41'$ south latitude and $56^{\circ}18'$ east longitude, in the northeast area of the Sea of Fertility, approximately 100 kilometers east of Webb crater. The mass of the spacecraft at landing was 1,880 kilograms. Less than an hour after landing, at 06:03 UT, an automatic drill penetrated the lunar surface to collect a soil sample. After drilling for 7 minutes, the drill reached a stop at 35 millimeters depth and then withdrew its sample

and lifted it in an arc to the top of the spacecraft, depositing the precious cargo in a small spherical capsule mounted on the main spacecraft bus. Finally, at 07:43 UT on 21 September, the spacecraft's upper stage lifted off from the Moon. Three days later, after a direct ascent traverse with no midcourse corrections, the capsule, with its 105 grams of lunar soil, reentered Earth's atmosphere at a velocity of 11 kilometers per second. The capsule parachuted down 80 kilometers southeast of the town of Dzhezkazgan in Kazakhstan at 05:25 UT on 24 September 1970. Analysis of the dark basalt material indicated a close resemblance to soil recovered by the American Apollo 12 mission.

121)

Zond 8

Nation: USSR (74)

Objective(s): circumlunar flight

Spacecraft: 7K-L1 (no. 14)

Spacecraft Mass: c. 5,375 kg

Mission Design and Management: TsKBEM

Launch Vehicle: 8K82K + Blok D (Proton-K no. 250-01)

Launch Date and Time: 20 October 1970 / 19:55:39 UT

Launch Site: NIIP-5 / launch site 81L

Scientific Instruments:

- 1) solar wind collector packages
- 2) imaging system

Results: Zond 8 was the last in the series of circumlunar spacecraft designed to rehearse a piloted circumlunar flight. The project was initiated in 1965 to compete with the Americans in the race to the Moon but lost its importance once three astronauts circled the Moon on the Apollo 8 mission in December 1968. After a midcourse correction on 22 October at a distance of 250,000 kilometers from Earth, Zond 8 reached the Moon without any apparent problems, circling its target on 24 October at a range of 1,200 kilometers. The spacecraft took black-and-white photographs of the lunar surface during two separate sessions. After two midcourse corrections on the return leg, Zond 8 flew a return over Earth's northern hemisphere instead of the standard southern approach profile, allowing Soviet ground control stations to maintain near-continuous contact with the ship. The guidance system evidently malfunctioned on the return leg, and

the spacecraft performed a simple ballistic (instead of a guided) reentry into Earth's atmosphere. The vehicle's descent module splashed down safely in the Indian Ocean at 13:55 UT on 27 October about 730 kilometers southeast of the Chagos Islands, 24 kilometers from its original target point.

122)

Luna 17 / Lunokhod 1

Nation: USSR (75)

Objective(s): lunar roving operations

Spacecraft: Ye-8 (no. 203)

Spacecraft Mass: 5,700 kg

Mission Design and Management: GSMZ

Lavochkin

Launch Vehicle: 8K82K + Blok D (Proton-K no. 251-01)

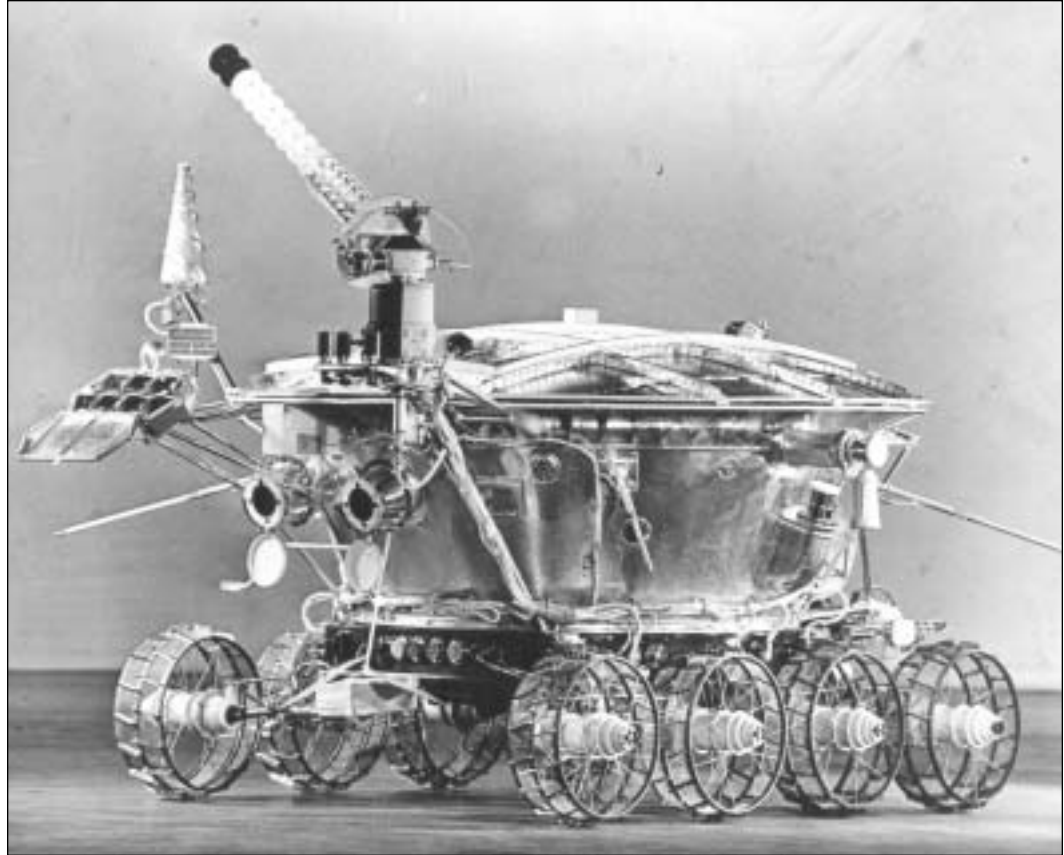
Launch Date and Time: 10 November 1970 / 14:44:01 UT

Launch Site: NIIP-5 / launch site 81L

Scientific Instruments:

- 1) imaging system (two low-resolution TVs and four high-resolution photometers)
- 2) x-ray spectrometer
- 3) penetrometer
- 4) laser reflector
- 5) radiation detectors
- 6) x-ray telescope
- 7) odometer/speedometer

Results: Luna 17 continued the spate of successes in Soviet lunar exploration begun by Luna 16 and Zond 8. Luna 17 carried Lunokhod 1, the first in a series of robot lunar roving vehicles whose conception had begun in the early 1960s, originally as part of the piloted lunar landing operations. This was the second attempt to land such a vehicle on the Moon after a failure in February 1969. The descent stage was equipped with two landing ramps for the "ascent stage," that is, the rover, to disembark onto the Moon's surface. The 756-kilogram rover stood about 1.35 meters high and was 2.15 meters across. Each of its eight wheels could be controlled independently for two forward and two reverse speeds. Its top speed was about 100 meters per hour, with commands issued by a five-man team of "drivers" on Earth who had to deal with the 5-second delay. The set of scientific instruments was powered by solar cells (installed on the inside of the hinged top lid of the rover) and



The Soviet Moon lander, Lunokhod 1.

chemical batteries. After two midcourse corrections en route to the Moon, Luna 17 entered lunar orbit and then landed on the lunar surface at 03:46:50 UT on 17 November 1970 at 38°17' north latitude and 35° west longitude, about 2,500 kilometers from the Luna 16 site in the Sea of Rains. The Lunokhod 1 rover rolled over the ramps and onto the lunar surface at 06:28 UT. The rover had an expected lifetime of three lunar days but operated for eleven. During its 322 Earth days of operation,

the rover traveled 10.54 kilometers and returned more than 20,000 TV images and 206 high-resolution panoramas. In addition, Lunokhod 1 performed twenty-five soil analyses with its RIFMA x-ray fluorescence spectrometer and used its penetrometer at 500 different locations. Controllers finished the last communications session with Lunokhod 1 at 13:05 UT on 14 September 1971. Attempts to reestablish contact were finally discontinued on 4 October.